COSEWIC
Assessment and Status Report

on the

Cutlip Minnow
Exoglossum maxillingua

in Canada

SPECIAL CONCERN
2013

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC
Assessment Summary

Assessment Summary – November 2013

Common name
Cutlip Minnow

Scientific name
Exoglossum maxillingua

Status
Special Concern

Reason for designation
This small-bodied freshwater fish occurs across a relatively small area in eastern Ontario and Quebec where it has been lost from two watersheds over the last 10 years. Much of the current range of this species is subject to threats from widespread habitat degradation and multiple invasive species.

Occurrence
Ontario, Quebec

Status history
Designated Not at Risk in April 1994. Status re-examined and designated Special Concern in November 2013.

COSEWIC
Executive Summary

Cutlip Minnow
Exoglossum maxillingua

Wildlife Species Description and Significance

The Cutlip Minnow, *Exoglossum maxillingua*, is a stout-bodied minnow that reaches a maximum length of 160 mm. It has silvery sides with a greenish purple sheen, and is distinguished from all other members of the family Cyprinidae in North America by its unique tri-lobed lower jaw.

Distribution

The Cutlip Minnow is commonly found in Atlantic coastal drainages of northeastern North America. There is, however, evidence of low and/or declining numbers in some river systems. In Canada, it has been reported in the St. Lawrence River drainage from Ivy Lea, Ontario, downstream to a tributary of the Rivière Saint-Denis near Saint-Pascal, Québec. Its range is limited in eastern Ontario where it is currently found in three of seven waterbodies where it has been collected historically and in the St. Lawrence River. It is more widespread in Québec where it has been found in numerous river systems from 1935 to present.

Habitat

The Cutlip Minnow is found primarily in clear or tea-coloured streams with a width of 1-20 m, on firm rocky bottoms, frequently mixed with gravel, sand, and mud. In Québec, it has also been found on hard clay and shale bottoms. Aquatic vegetation is often present and water current is slow. It has been found in water up to 26°C in June and July. It has been found in the St. Lawrence River typically at the lower end of fast-flowing runs. The Cutlip Minnow is also known from lakes at elevations of up to 380 m in the Laurentians in Québec.

Biology

Little is known of the biology of the Cutlip Minnow in Canada. In its American range, it is a specialized bottom feeder, but may shift to other food sources when its preferred food is unavailable. It consumes a variety of aquatic invertebrates including trichopteran larvae, oligochaetes, plecopterans, chironomids and molluscs. Although age at spawning is unknown, nest building by a 76 mm male has been reported, with spawning males usually averaging 102-140 mm in length. Spawning females are usually not over 76 mm. Spawning season in central New York begins near the end of May and lasts to the middle of July. Spawning occurs in the daytime, peaking at mid-day and late afternoon at temperatures of 17-21.5°C. Spawning may occur later in Canada. Fecundity varies from 345 to 1,177 eggs per female in southeastern New York. The Cutlip Minnow grows to a maximum of 160 mm and age four.

Population Sizes and Trends

Canadian populations are at the northern edge of the range of the species. In Québec, Cutlip Minnow is currently known from 79 of 206 waterbodies where it was historically present. In Ontario, it is currently found in three of seven waterbodies where it was historically present and in the St. Lawrence River. It is, however, difficult to determine if these potential declines are the result of the actual decline in the species, a lack of recent sampling, or a combination thereof.

Threats and Limiting Factors

No imminent threats have been documented for the Cutlip Minnow. It is probably intolerant of turbidity and excessive siltation, which are consequences of agricultural and urbanization activities, especially during spawning. The invasive Round Goby, known to negatively impact native benthic fishes, and Tench are present in the St. Lawrence River and may impact this species. The Common Shiner may adversely affect the reproduction of the Cutlip Minnow as the former is known to breed on the nests of the latter species. Harsher climatic conditions probably also adversely affect the life span of Canadian populations and, because the Cutlip Minnow prefers relatively warm streams, may limit its northward dispersal.

Protection, Status, and Ranks

The Cutlip Minnow is listed as Threatened under the Ontario *Endangered Species Act*, 2007. Fish habitat is protected by the federal *Fisheries Act* only in so far as the Cutlip Minnow shares habitat with other fishes that are of Commercial, Recreational, or Aboriginal fishery significance. The species is listed as secure both globally (G5) and in the United States (N5). In Canada, it is ranked as apparently secure (N4). Provincially, it is ranked critically imperilled/imperilled (S1/S2) in Ontario and apparently secure (S4) in Québec.

TECHNICAL SUMMARY

Exoglossum maxillingua

Cutlip Minnow Bec-de-lièvre

Range of occurrence in Canada (province/territory/ocean): Ontario, Québec

Demographic Information

Generation time (usually average age of parents in the population	2.4 y (FishBase)
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? Inferred from loss of locations in Ontario. In Québec, it is difficult to determine if these potential declines are the result of the actual decline in the species, a lack of recent sampling, or a combination thereof.	Yes
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	No
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence Pre-2002: 67,676 km^2	60,821 km^2
Index of area of occupancy (IAO) (Always report 2x2 grid value). Pre-2002: (2,020 km^2). Declines in IAO are based on loss of two populations in Ontario and the IAO could be as low as 660 km^2. Uncertainty about continued presence of some populations in Québec, many of which appear not to have been re-sampled after 1991, makes knowledge of current IAO uncertain.	~2,000 km^2
Is the total population severely fragmented?	No
Number of locations∗	>10
Is there an observed continuing decline in extent of occurrence? Certainly in Ontario, possibly in Québec	Yes

∗ See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Is there an observed continuing decline in index of area of occupancy? Certainly in Ontario, possibly in Québec	Yes
Is there an observed continuing decline in number of populations? Certainly in Ontario, possibly in Québec.	Yes
Is there an observed continuing decline in number of locations*? Certainly in Ontario, possibly in Québec.	Yes
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? Several instances of continuing loss of habitat and habitat quality in parts of range both in Ontario and Québec (Raisin River, Lac Saint-Pierre)	Probably
Are there extreme fluctuations in number of populations?	Unknown
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Unknown

Threats (actual or imminent, to populations or habitats)

No imminent threats have been documented. Poor water quality and invasive species, especially the Round Goby, are possible threats through much of the range as is urbanization in the Montréal area.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? New York (S5); Vermont (S3)	
Is immigration known or possible?	Possible
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely? Rescue is likely in large interconnected areas like the mainstem St. Lawrence River, but unlikely in smaller tributaries and lakes.	Perhaps

Status History

COSEWIC: Designated Not at Risk in April 1994. Status re-examined and designated Special Concern in November 2013.

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code:** Not applicable
Reason for Designation: This small-bodied freshwater fish occurs across a relatively small area in eastern Ontario and Québec where it has been lost from two watersheds over the last 10 years. Much of the current range of this species is subject to threats from widespread habitat degradation and multiple invasive species.	
Criterion A: Not applicable. No data to assess abundance trends.	
Criterion B: Not applicable. Comes close to meeting Threatened under criterion **B2** since the IAO is close to the threshold value (2000 km²) and sub-criterion **b(ii,iii)** is applicable.	
Criterion C: Not applicable. Number of mature individuals unknown.	
Criterion D: Not applicable. Exceeds all criteria.	
Criterion E: Not applicable. Data necessary for application not available.	

PREFACE

The Cutlip Minnow remains a poorly studied and monitored species—very little has been published on its biology since the last COSEWIC report. All sites where it had been found in southeastern Ontario, and many adjacent sites, have been sampled since the last report and it is currently found in only three of seven waterbodies where it was historically present and in the St. Lawrence River. In Québec, Cutlip Minnow is currently known from 79 of 206 waterbodies where it was historically present. The extent to which the historical sites were recently sampled in Québec is not fully known. Comparing records from the last 10 years to historical records, the extent of occurrence has declined by 13.3% and the index of area of occupancy may have declined by more than 60%. Insufficient sampling has occurred to determine trends in abundance. Although threats specific to Cutlip Minnow are unknown, they are believed to be degradation of habitat and water quality, and invasive species—all ongoing threats within their distribution in Canada.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2013)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Class: Actinopterygii

Order: Cypriniformes

Family: Cyprinidae

Species : *Cyprinus maxillingua*, LeSueur 1817c: 85
Exoglossum lesuianum, Rafinesque 1818e: 420
Exoglossum maxillingua, Scott 1967: 70

English Common Name: Cutlip Minnow (Nelson *et al.* 2004)

French Common Name: Bec-de-lièvre (Nelson *et al.* 2004)

The Cutlip Minnow, *Exoglossum maxillingua* (Figure 1), has only one known congener, the Tonguetied Minnow, *Exoglossum laurae* (Page and Burr 2011). This latter species is known only from the northeastern United States, has a lower jaw that is not as obviously tri-lobed, and frequently possesses a maxillary barbel. The ranges of these two species only overlap in southwestern New York (Page and Burr 2011). The Cutlip Minnow is currently considered to be derived from *E*. *laurae* (Gilbert and Lee 1980). Phylogenetic analysis indicates that the genus *Exoglossum* is most closely related to *Phenacobius*, a genus of minnows restricted to the Mississippi and Gulf of Mexico drainages of the United States (Coburn and Cavender 1992). The common name Cutlips Minnow was officially changed to Cutlip Minnow in 2004 (Nelson *et al.* 2004).

Figure 1. The Cutlip Minnow, *Exoglossum maxillingua.* Drawn by Ellen Edmonson. Reproduced with permission by Bureau of Fisheries, New York State Department of Environmental Conservation.

Morphological Description

The Cutlip Minnow is a stout-bodied minnow that can reach a length of about 160 mm (Holm *et al.* 2010). It can be distinguished from all other North American minnows by its unique tri-lobed lower jaw consisting of a central bony tongue-like lobe, two lateral fleshy lobes, and no maxillary barbels (Page and Burr 2011). Adult Cutlip Minnow have an olive-grey to olive-green back, silvery sides with a greenish purple sheen, and a white belly (Holm *et al.* 2010). Other than the reproductive season, there are no obvious external differences between the sexes. During the reproductive season, mature males develop tubercles on the paired fins (Pappantoniou 1983). Juveniles have a stripe along the midline and a distinct spot at the base of the caudal fin (Holm *et al.* 2010). Larval development of the Cutlip Minnow has been described by Fuiman and Loos (1978) and Buynak and Mohr (1980). The latter reference provides a key to six species of cyprinids, four of which are frequently found in association with Cutlip Minnow in Canada.

Population Spatial Structure and Variability

Pappantoniou (1983) examined geographic variation in the Cutlip Minnow in the United States using four morphometric and seven meristic characters from 1,247 specimens, including five individuals from the St. Lawrence drainage. Ten characters displayed significant geographic variation among populations, but the variation was not correlated with latitude. Population and genetic studies have yet to be completed on Cutlip Minnow in Canada; therefore, little is known on the population structure and genetic variability of the species.

Designatable Units

As a result of a lack of population and genetic studies on Canadian populations and the occurrence of all populations in a single COSEWIC National Freshwater Biogeographic Zone (COSEWIC 2012), the Great Lakes-Upper St. Lawrence Biogeographic Zone, the Canadian populations of Cutlip Minnow are considered to constitute a single designatable unit.

Special Significance

The Cutlip Minnow possesses some unique morphological and behavioural characteristics. Its lips are unlike those of any other North American minnow. It is known to attack and consume the eyes of other species of fishes (Johnson and Johnson 1982), a behaviour useful in experiments on the effectiveness of eye camouflage (Pappantoniou 1983) and source of its slang common name “eye picker” (Scott and Crossman 1973). This species is one of few minnows that demonstrate post-hatching care of fry (Smith 1991).

DISTRIBUTION

Global Range

The Cutlip Minnow is found in northeastern North America (Figure 2) in the Atlantic drainage from the St. Lawrence and lower Ottawa river systems in Ontario and Québec south to southern Virginia (Page and Burr 2011). It is typically found in upland areas such as the Adirondack, Allegheny, Catskill and Laurentian mountains and is not found in lowland coastal areas such as most of New Jersey and the Delaware Peninsula. The Cutlip Minnow is found in the New River system and Ohio River drainage of Virginia and West Virginia likely from introductions as a bait fish (Stauffer *et al.* 1995; Nico 2011).

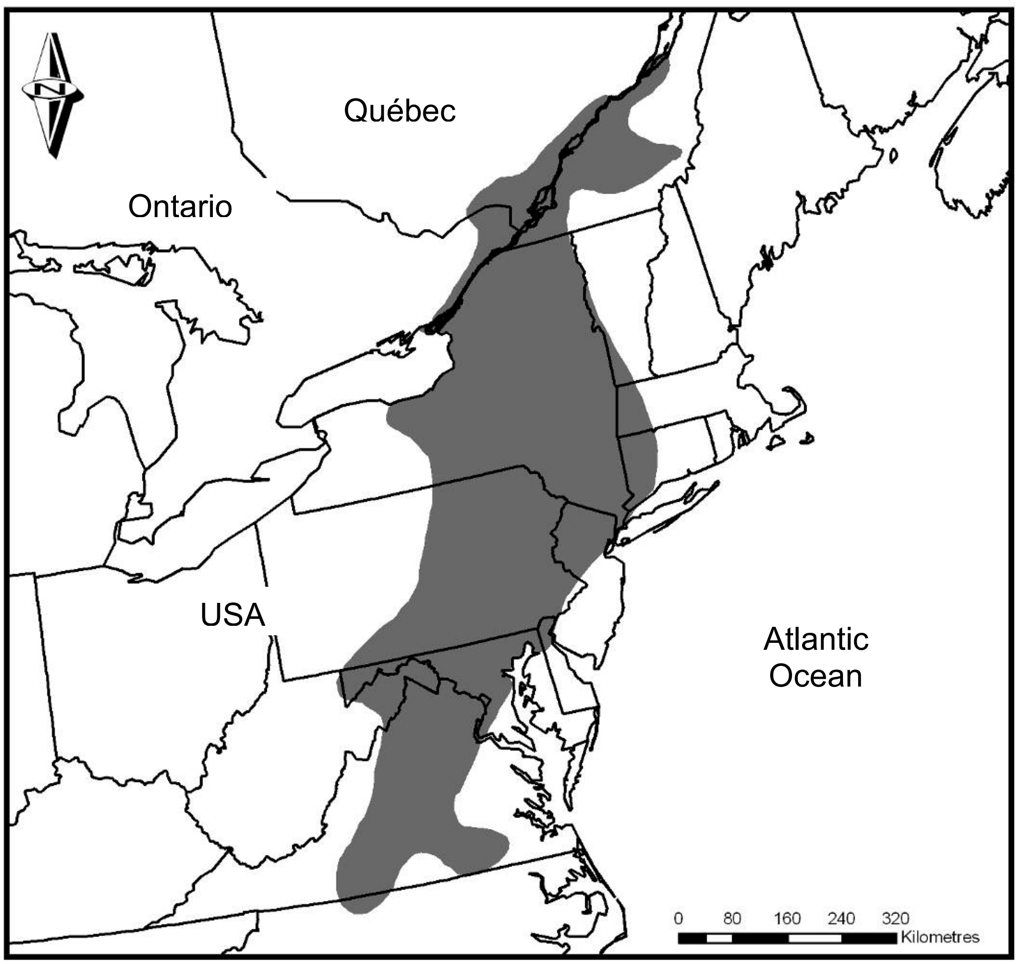

Figure 2. Global distribution of Cutlip Minnow, *Exoglossum maxillingua.* Modified from Page and Burr (2011).

Canadian Range

In Canada, the Cutlip Minnow is found in the St. Lawrence River, including Lac Saint-François, and its tributaries, from a tributary of the Rivière Saint-Denis near Saint-Pascal, Québec (the northernmost record known) upstream in the St. Lawrence River to Ivy Lea, Ontario (Figures 3 and 4). It is known from the lower Ottawa River system as far upstream as Rivière du Diable in the Rivière Rouge system (see Table 1). Nash (1908) stated that the species occurred in Lake Ontario. There are, however, no voucher specimens with which to substantiate its presence in the Ontario portion of the lake (Holm *et al.* 2010), but it has been reported from New York tributaries of Lake Ontario (Page and Burr 2011).

Table 1. Waterbodies, by drainage, where Cutlip Minnow has been successfully collected in Québec across sample years. Records dated prior to 1996 are primarily from Crossman and Holm (1996). Older records not in Crossman and Holm (1996) and records since 1996 are from the sources identified in the text and from unpublished Québec data compiled by Nathalie Vachon with the assistance of other biologists in Québec. NL = unnamed.

Wshed level 0	Wshed level 1	Wshed level 2	Wshed level 3	Waterbody	Year
SAINT-LAURENT	SECT. ÎLE ORLÉANS			Fleuve Saint-Laurent	1971 2006
	SECT. ÎLES FLUVIALES MONTRÉAL			Aff D Fleuve Saint-Laurent	1977
				CREEK (NL)	1977
				Fleuve Saint-Laurent	1941 1967 1972 1973 1974 1976 1977 1983 1989 2001
	SECT. LAC SAINT-FRANÇOIS			Rivière Saint-Charles	1941
				Lac Saint-François	1938 1976 1994
	SECT. LAC SAINT-LOUIS			Lac Saint-Louis	1941 1942 1976
	SECT. LAC SAINT-PIERRE			Chenal aux Ours	1971
				Chenal du Nord	1971
				Fleuve Saint-Laurent	1941 1971
	SECT. FLUVIAL AMONT Québec			Fleuve Saint-Laurent	2002
	SECT. LES CÈDRES			Fleuve Saint-Laurent	1942 1971 1975 1979 1980
	OUTAOUAIS	À LA RAQUETTE		Rivière à La Raquette	1964
		DE LA PETITE NATION	IROQUOIS	Ruisseau Iroquois	1981
				Trib. of ruisseau Iroquois	2006 2007
			LAROCHE	Rivière Laroche	2001 2007
			PETITE RIVIÈRE ROUGE	unknown	1964
		DU NORD	AUX MULETS	Lac Saint-Denis	1960 1966
				Rivière aux Mulets	2007
			DE L'OUEST	Lac La Rivière	1967
				Rivières de l'Ouest	1975 1976 1988
				Lac Louisa	1963 1983

Wshed level 0	Wshed level 1	Wshed level 2	Wshed level 3	Waterbody	Year
			SIMON	Émissaire du lac Bouchette	2007
				Ruisseau Jackson	2007
				Lac Gemont	1967
				Lac Sainte-Marie	1991 2008
				Rivière Simon	2009
			WILLIAMS	Lac Barron	1985
				Lac Sir-John	1992 1994
				Ruisseau Williams	1994 1992 1999 2000 2002 2003 2004 2005 2006 2007 2008 2009
				Rivière Bellefeuille	2007
				Ruisseau Bonniebrook	2007
				Rivière Dalesville	1976
				Rivière de l’Est	1987
				Grand Ruisseau	2005
				NON NOMMÉ	2007
				Rivière du Nord	1991 1992
				Ruisseau à Régimbald	2007
		RIGAUD		Rivière à La Graisse	1972
				Rivière Rigaud	1964 1965 1966 1972
		ROUGE	BEAVEN	Rivière Beaven	2007
				Émissaire du lac Brochet	2001 2007
				Lac Laurel	1988
				Rivière Perdue	2007
				Ruisseau Avalanche	1998 2002 2004 2005 2006 2008 2009
				Rivière Cachée	2007
				Ruisseau Noir	2007
				Ruisseau Larose	2007
				Ruisseau Mercier	2004 2005 2007 2008
				Rivière du Diable	1968
				Rivière Rouge	1941 1998 2000
				Lac des Deux Montagnes	1976
				Ruisseau à Charette	1976
	DES MILLE-ÎLES	DU CHÊNE		Rivière du Chêne	1965
				La Petite Rivière	1970
				unknown	1965 1970
	AUX SAUMONS			Rivière aux Saumons	1976 2008
	BEAUDETTE			Rivière Beaudette	1946 1970 1971
	CHAMBERRY			Ruisseau Chamberry	1976
	CHATEAUGUAY	AUX OUTARDES		CREEK (NL)	1976
				Rivière aux Outardes	1976
				Rivière aux Outardes Est	1976 1991 1996 2002 2006
				Ruisseau Mitchell	1963 1976 2002 2006
				Trib. Rivière aux Outardes Est	1976
				Trib. Ruisseau Mitchell	1976

Wshed level 0	Wshed level 1	Wshed level 2	Wshed level 3	Waterbody	Year
		DES ANGLAIS	ALLEN	Ruisseau Allen	1976 2006 2009 2011 2012
				Trib. Ruisseau Allen	1976
				Rivière des Anglais	1942 1976 1996 2006 2009 2010 2011 2012
				Ruisseau Robson	1976 2009
		DEWITT		Ruisseau Dewitt	1976 1970
		HINCHINBROOK		Rivière Hinchinbrook	1941 1961 1963 1976 1989 2006 2012
				Ruisseau Collins	1941 1963
		OAK		Ruisseau Oak	1967 1976 2006
		TROUT		Rivière Trout	1941 1942 1976 1996 2006 2010 2011 2012
				Rivière Châteauguay	1941 1942 1946 1960 1961 1963 1975 1976 2006
	RICHELIEU	BEAUVAIS		Ruisseau Beauvais	1965
		L'ACADIE	MASSE	Ruisseau Canal Saint-Bruno	1988
	SUZANNE			Rivière Suzanne	1977
	ASSOMPTION	ACHIGAN		Rivière Abercromby	2007
				Lac Cromwell	2007 2008
				NON NOMMÉ	2007
				Rivière l'Achigan	1968 2007 2008
	BAYONNE			Rivière Bayonne	1971
				Ruisseau Bibeau	1971
	CHICOT			Trib. Rivière Chicot	1971
				CREEK (NL)	1971
				Émissaire du lac Dupras	1971
				Rivière Chicot	1971
				Ruisseau Saint-André	1971
	LA CHALOUPE			Rivière La Chaloupe	1941 1971
	AUX ORIGNAUX			Rivière aux Orignaux	1982 1984
				Ruisseau Sanitorio	1982 1984
	BECANCOUR	BLANCHE		Rivière Blanche	2011 2013
				Ruisseau Perreault	2011
		BULLARD		Ruisseau Bullard	1934 2013
		NOIRE		Rivière Noire	2011
		PALMER		Rivière Bécancour	1935 1964 2013
				Rivière aux Chevreuils	1971
	GENTILLY	GENTILLY SUD-OUEST		Rivière Gentilly Sud-Ouest	1982 1984
		LE PETIT BRAS		Ruisseau le Bras	1941 1984
				Rivière Gentilly	1982 1984
	MASKINONGÉ			Rivière Maskinongé	1967
	NICOLET	BULSTRODE		Rivière Bulstrode	1977 1987 1989 2012 2013
		DES PINS		Rivière des Pins	1933
		GOSSELIN		CREEK (NL)	1977
		NICOLET SUD-OUEST		Ruisseau Francoeur	1933 1935

Wshed level 0	Wshed level 1	Wshed level 2	Wshed level 3	Waterbody	Year
				Rivière des Rosiers	1935
				Rivière Nicolet Centre	1977
				Rivière Nicolet Nord-Est	1977
				Rivière Nicolet Sud-Ouest	1977 2013
				Rivière Nicolet	1933 1977 1984 2013
	PETITE RIVIÈRE DU CHÊNE	AUX ORMES		CREEK (NL)	1982
				Rivière aux Ormes	1941 1984
		CREUSE		Rivière Creuse	1984 1982
		ESPÉRANCE		Ruisseau l'Espérance	1982 1984
				Petite rivière du Chêne	1941 1982 1984
	SAINTE-ANNE	NOIRE		unknown	1995
				Rivière Charest	1979
				Rivière Sainte-Anne	1979 1995 2002
	SAINT-FRANÇOIS	AU SAUMON		Rivière au Saumon	2009
		AUX BLUETS		Rivière aux Bleuets	1996
				Ruisseau Vaseux	1999
		ULVERTON		Cours d'eau Daoust	1932
				Rivière Ulverton	1932 1935
				Rivière aux Vaches	1944
				Rivière Saint-François	1974 2009
	YAMACHICHE			Grande Rivière Yamachiche	1972
				Rivière Yamachiche	1972 1973
	YAMASKA	DAVID		Rivière Saint-David	1970
	BOYER			Rivière Boyer	1941 1971 1992 2002 2007
		BOYER NORD		Rivière Boyer Nord	1971 1992 1995 2005
		BOYER SUD		Rivière Boily	1971
				Rivière Boyer Sud	1971
		DU PORTAGE		Rivière Boyer	1971
	CHAUDIÈRE	BEAURIVAGE		Rivière Beaurivage	1964 1996 200 2003 2005 2006 2008 2010
				Rivière Cugnet	1998 2010
				Bras d'Henri	1980
				Rivière Filkars	1980
				Rivière aux Pins	2006
				Rivière du Loup	2006
				Tributaire de la rivière Beaurivage	1999
		BRAS SAINT-VICTOR		Rivière du Cinq	1965 1977 2011
				Bras Saint-Victor	1965 1994 1999
				Rivière Fortin-Dupuis	1998
				Rivière Prévost-Gilbert	2001
				Rivière des Ormes	1996
				Décharge du Dix	1975

Wshed level 0	Wshed level 1	Wshed level 2	Wshed level 3	Waterbody	Year
		DU LOUP		Ruisseau Boutin	2004
				Rivière du Loup (Linière)	2001 2002 2006
				Rivière du Monument	2002
				Ruisseau Oliva	2006
				Rivière du Portage	2000
				Rivière Vachon	2003
		FAMINE		Rivière Cumberland	2005
				Rivière des Abénakis Sud-Est	2003
				Rivière des Abénakis Sud-Ouest	2000
				Ruisseau des Acadiens	1998
				Rivière Famine	1999 2002 2005
		POZER		Rivière Pozer	1991 1998 1999
				Branche Victor-Loubier	2002
				Rivière Calway	1994
				Rivière Chassé	1963
				Ruisseau Doyon	1994
				Rivière Pouliot	1980
				Rivière Vallée	1963 2002
				Rivière du Moulin	2001 2002 2005
				Rivière Chaudière	1941 1949 1976 1994 1998 1999 2000 2001 2002 2003 2004 2005
	DU CHÊNE	AUX CHEVREUILS		Rivière aux Chevreuils	1971 1986 1987 2003 2006
		BOIS-CLAIR		Rivière Bois-Clair	1971
				Bras des Boucher	1971
		HENRI		Rivière Henri	1971 1986 1997 2002 2005 2008 2010
				Rivière aux Cèdres	1971
		HURON		CREEK (NL)	1971
				Branche Rémi-Plante	1971
				Rivière aux Ormes	1971
				Rivière Huron	1971 2008
				Bras d'Émond	1971
				Grande Rivière du Chêne	1971 1997 2002 2005 2010
	DU SUD	BRAS SAINT-MICHEL		Bras Saint-Michel	1941 1998 2005
				Ruisseau de la Chute	2001
		BRAS SAINT-NICOLAS		Bras Saint-Nicolas	1975 1941 1980 1997 1998 2003 2007 2010 2012
				Décharge du lac Pain-de-Sucre	2006
				Grand Fossé	1983
				Rivière des Perdrix	2000
				Ruisseau des Prairies	1986
		MORIGEAU		Rivière Morigeau	2005 2007 2009
				Rivière Campagna	1982 2005
				Rivière Minguy	2011

Wshed level 0	Wshed level 1	Wshed level 2	Wshed level 3	Waterbody	Year
				Rivière du Sud	1940 1941 1964 1996 1997 1992 2004 2005
	ETCHEMIN	BOIS-CLAIR		Trib Rivière Bois-Clair	1971
				Rivière Bois-Clair	1971
		LE BRAS		Rivière Le Bras	1962 1997 1998 2003 2009 2010
				Ruisseau Fourchette	1962 2001
				Rivière Etchemin	1962 1963 1991 1996 2000 2002 2005 2006 2009 2010
	FERRÉE			Rivière Férrée	1941
				Rivière Joncas	2007
	PORT-JOLI			Rivière Port-Joli	1998
	TORTUE			Rivière Tortue Sud-Est	1998 2008
	JACQUES-CARTIER			Rivière Jacques-Cartier	1981 1986 1990 1994 2001 2002
	PORTNEUF			Émissaire du Lac Sergent	2002
				Rivière Portneuf	1999 1996
	AUX PERLES			CREEK (NL)	1941
				Rivière Kamouraska	1941
				Rivière Saint-Denis	1941
	OUELLE			Rivière Ouelle	1964 1968 1983 1986 1987 1988 1989 1990 1991 1992 1993 1999 2000 2001 2002 2003 2004 2005 2006 2007

Extent of Occurrence and Area of Occupancy

Sampling efforts in the Ontario portion of the range of the Cutlip Minnow over the last 10 years suggest that the species no longer exists at the western extreme of its range at Ivy Lea and in the Delisle River in eastern Ontario (Figure 3, Table 2). The Cutlip Minnow may have been lost from numerous sites in Québec (Figure 4). Based on comparisons between historical records and current estimates of distribution, the extent of occurrence (EO) may have decreased from 67,676 km^2 to 60,821 km^2, representing a 10.2% decline. The index of area of occupancy (IAO) may have declined from 2,021 km^2 to 658 km^2, representing a 67.4% decline. It is difficult, however, to determine if these potential declines in EO and IAO are the result of an actual decline in the species, a lack of sampling, or a combination thereof, at least in Québec. In Ontario, where sampling is more quantitative, there has likely been a loss of IAO of about 20% since 1991 (Table 2; Figure 3). The number of locations was estimated as the number of independent watersheds inhabited by the Cutlip Minnow. There are no studies on population connectivity inferred from genetic assays, but morphometric distinctions amongst populations demonstrated by Pappantoniou (1983), evidence of separation of some populations by large stretches of unsuitable habitat that may inhibit movement (see **Dispersal and Migration** below and Jacobs 2011) and the site-specific nature of the most serious threats to Cutlip Minnow are at least consistent with a watershed level definition of locations of which there are at least 10 (Tables 1 and 2).

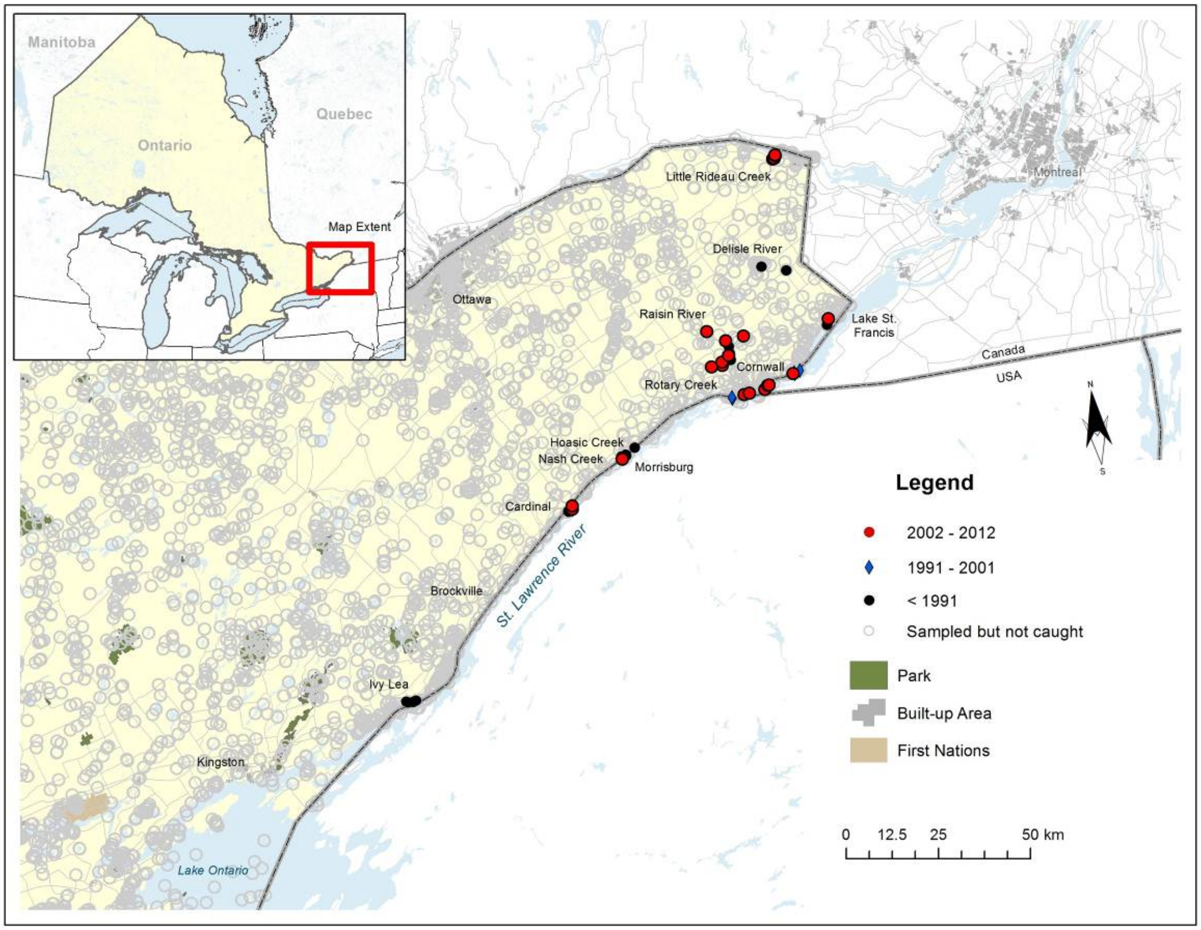

Figure 3. Distribution of Cutlip Minnow, *Exoglossum maxillingua,* in Ontario. Closed symbols represent sites where the species has been collected by time period. Open circles represent sites sampled without capturing the species (primarily by the Royal Ontario Museum, 1920s-present, Ontario Ministry of Natural Resources, 1970s, and DFO, 2002-2012).

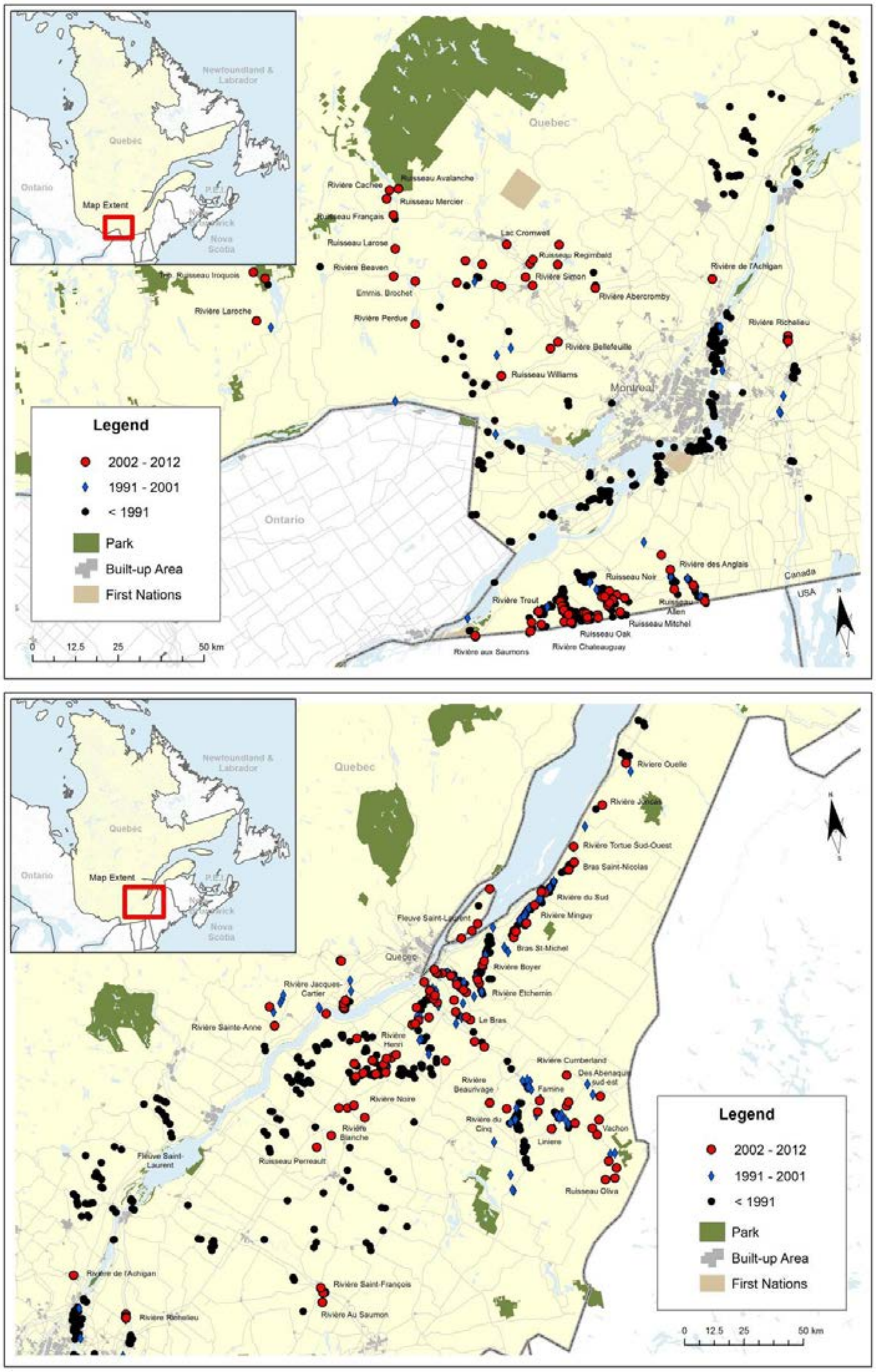

Figure 4. Distribution of Cutlip Minnow, *Exoglossum maxillingua*, in western (top) and eastern (bottom) Québec. Closed symbols represent sites where the species has been collected by time period. Sites sampled without capturing the species were not available.

Table 2. Waterbodies, by drainage, where Cutlip Minnow has been successfully collected in Ontario. Failed collection years represent known failed collections and are not necessarily comprehensive. Records dated prior to 1996 are primarily from Crossman and Holm (1996). Older records not in Crossman and Holm (1996) and records since 1996 are from the sources identified in the text. NL = unnamed.

Watershed	Waterbody	Successful Collection Years	Failed Collection Years
Ottawa River	Little Rideau Creek	1978, 1989, 2001, 2004, 2010	
Raisin River	North Raisin River	1973, 1989	
	Raisin River	1973, 1989, 2004, 2008, 2009	
St. Lawrence River	at Ivy Lea	1936, 1937, 1967, 1994	2009
	at Cardinal	1981, 1994, 2008, 2009	
	at Morrisburg	2009	
	at Cornwall	1994, 2008, 2009	
	Delisle River	1936, 1938, 1942, 1946, 1970	1973, 1978, 2004, 2010
	Hoasic Creek (Nash Creek)	1938	2004, 2010
	Rotary Creek	2008, 2009	
	St. Lawrence Creek (NL)	1938	1967, 1989, 2004

Search Effort

Most of the surveys that have detected Cutlip Minnow were not specifically targeting the species, and sampling gears were often different among studies. Data on search effort, and often sampling gear, are not readily available for most historical surveys (earlier than the year 1990). In Québec, regional sampling of fish communities in the St. Lawrence River, Richelieu River, and Missisquoi Bay (Lake Champlain) occurs on a regular basis through the *Réseau de Suivi Ichtyologique* (Fish Monitoring Network, Table 1). In eastern Ontario, several surveys have been recently conducted to assess the status of species at risk (Dextrase and Reid 2004; Edwards *et al.* 2011; Jacobs 2009, 2010, 2011). These surveys have resulted in the sampling of all known historical Cutlip Minnow locations within the last 10 years (Table 2). Additional targeted surveys, using gear types proven efficient at detecting the species and sampling at appropriate times, will provide a more accurate picture of the status of the Cutlip Minnow in Canada.

HABITAT

Habitat Requirements

In the United States, the Cutlip Minnow is usually found in small to moderate-sized clear streams, 4.6-15m in width. It prefers quiet pools or channels with gentle to moderately swift current, and has been found in depths of 0.15 to 1.2m, in temperatures ranging from 0 to 26°C, and over firm bottoms of rubble, gravel, boulders, and cobbles. In-stream cover, such as large rocks, logs, vegetation, or overhanging banks, is an important component of the habitat of this species (Hankinson 1922; Van Duzer 1939; Haase and Haase 1975; Cooper 1983; Pappantoniou 1983; Smith 1985). In Connecticut, total alkalinity ranged from 7 to 137 and hardness 22-184, both mg/l equivalents $CaCO_3$ (Whitworth *et al.* 1968). Bottom type consisted of stone or rubble (35%), gravel (30%), silt (13%), rock (9%), muck (9%), and sand (4%).

In Canada, the Cutlip Minnow is found primarily in clear or tea-coloured warmwater streams, on firm rocky bottoms frequently mixed with one or more combinations of cobble, gravel, sand, and mud (Scott and Crossman 1973; Holm *et al.* 2010). In Québec, it is frequently found on hard clay and shale bottoms (P. Dumont, pers. obs. in Crossman and Holm 1996). Aquatic vegetation is often present (Bernatchez and Giroux 2000) and water current varies from still to fast, but is usually described as slow. It has been found in water temperatures up to 26°C in June and July. Streams are usually small with a width of 1-20 m, but populations have also been found in the St. Lawrence River and its lake-like expansions several kilometres wide. In the St. Lawrence River, it was most commonly found below fast-flowing runs (Crossman and Holm 1996). The Cutlip Minnow is also known from lakes at elevations of up to 380m in the Laurentian Mountains in Québec (Crossman and Holm 1996). In the Raisin River drainage, all sites with Cutlip Minnow exhibited similar habitat features with a combination of riffles and pools, and a clean stony substrate (Jacobs 2011). In Little Rideau Creek, riffles and pools with rocky substrates were also prevalent but the stream may become turbid after storm events (Dextrase and Reid 2004).

Habitat Trends

In Québec, agricultural activities have intensified over the past 50 years, resulting in increased stress on aquatic environments (Boucher *et al.* 2011). The St. Lawrence River lowlands have a significant proportion of agricultural land, and include a large portion of the Cutlip Minnow distribution in Canada. The Cutlip Minnow has also been found in watersheds of the four most polluted rivers in the province (i.e., Assomption, Richelieu, Saint-François, and Yamaska rivers). Water quality in these rivers is poor, and very poor in the case of the Yamaska River, with high concentrations of nutrients (nitrogen, phosphorus), pesticides, suspended matter, and organic matter (Simard 2004; Hudon and Carignan 2008). The St. Lawrence River in the vicinity of Montréal has been impacted by pollutants from the industrialized areas of the city. The closure of some facilities and other efforts (improved domestic and industrial effluent treatment) made over the last 25 years, however, have resulted in a reduction of contaminated waste and an overall improvement in the health of the St. Lawrence River (SLV 2008).

A recent study has documented the deterioration of aquatic habitats along a shallow 15 km long reach of the south shore of Lac Saint-Pierre, which is under the direct influence of agricultural watersheds (Hudon *et al.* 2012). The study revealed that the nutrient-enriched zones near tributary mouths supported higher biomass of submerged aquatic vegetation. The slow percolation of water through these large vegetation mats resulted in nitrogen-deficient zones downstream of the tributary mouths. This nutrient reduction resulted in the reduction in biomass of submerged aquatic vegetation, invertebrates, and small and large fishes. In addition, filamentous chlorophytes were replaced by benthic mats of filamentous cyanobacteria. These changes have resulted in reduced fish habitat quality and prey quantity and availability that, in part, has been implicated in recent Yellow Perch (*Perca flavescens*) recruitment failure and stock collapse (Magnan *et al.*, in prep.). In the upper St. Lawrence River, water clarity, as measured by Secchi depth, has increased from an average of 3.5 m in the 1970s to 6-7 m recently, likely as a result of declining phosphorus levels following improved sewage treatment, decreased levels of industrial pollution, and less agricultural runoff (Farrell *et al.* 2010). During this same period, overall zooplankton density has declined and native benthic invertebrate density has remained consistent, except for native unionids that have disappeared (Farrell *et al.* 2010). The loss of native unionid species is likely the result of the establishment and increase in abundance of Zebra Mussel (*Dreissena polymorpha*) and, more recently, Quagga Mussel (*Dreissena bugensis*) (Farrell *et al.* 2010). Most recently, invasive Round Goby (*Neogobius melanostomus*) has become abundant (Farrell *et al.* 2010).

In eastern Ontario, habitat loss is likely occurring in the streams in the Lac Saint-François watershed (e.g., Wood, Gunn, and Finney creeks located near Cornwall, Ontario) and in many other small tributaries in the St. Lawrence lowlands due to intensive agriculture associated with feed-lot and dairy cattle, mixed pasture, and corn and soya crops. The streams in these areas have been channelized for field drainage and have high loadings of pesticides, nutrients, and suspended sediment (M. Eckersley, OMNR, Kemptville, pers. comm., cited in Holm *et al.* 2001; Simard 2004; Gangbazo *et al.* 2005). Furthermore, the Raisin River Conservation Authority (2007) produced water quality report cards for the Raisin River itself and several tributaries. For the Raisin River, Hoasic Creek and Rivière Delisle, surface water quality grades were C+, D and D-. Grades for Finney and Gunn creeks were F and D-, all of which indicate that water quality is only fair to very poor.

BIOLOGY

Life Cycle and Reproduction

Age composition of populations in New York and Pennsylvania has been shown to differ considerably. Predominant age classes vary from I+ in eastern Pennsylvania (Pappantoniou *et al.* 1984a) to III+ in southeastern New York (Pappantoniou *et al.* 1984b). The following sizes at annulus formation were determined for age classes in the Waccabuc River in eastern Pennsylvania: I, 37-52 mm; II, 63-81 mm; III, 88-108 mm; IV, 110-126 mm (Pappantoniou *et al.* 1984b). Previous studies indicated that overlap in sizes occurs between year classes (Breder and Crawford 1922; Haase and Haase 1975). Maximum age is usually IV+, but specimens have been found to be V+ in a fertile stream in Pennsylvania (Haase and Haase 1975). The estimated generation time for Cutlip Minnow is 2.4 years, Fishbase (2013).

The Cutlip Minnow is a relatively specialized bottom feeder, but is apparently able to shift to other food resources when its preferred food is unavailable. Several studies have been conducted on its diet in New York and Pennsylvania (Breder and Crawford 1922; Haase and Haase 1975; Johnson 1981; Pappantoniou 1983; Pappantoniou *et al.* 1984a, b). The studies indicated that Cutlip Minnow consumes a variety of aquatic invertebrates, but chironomids, trichopteran larvae, and oligochaetes are the most important items. Younger individuals consume a much larger proportion of chironomids, whereas older individuals favour larger food items such as trichopterans, oligochaetes and plecopterans. Breder and Crawford (1922) found, in addition to unidentified insect remains (34%), a large proportion of oligochaetes and polychaetes (30%), and the gut contained diatoms and plant remains (15%), which Breder and Crawford believed were being digested. Seasonal variation of the benthos was reflected in the diet in the Delaware River in Pennsylvania (Haase and Haase 1975). When chironomid and trichopteran populations were low in September, they fed more on molluscs.

Spawning males usually averaged 102-140 mm in length and females were usually not over 76 mm; however, nest building by a 76 mm male in central New York has been reported (Van Duzer 1939). Spawning season in the Susquehanna River system of central New York lasted approximately seven weeks, 25 May to mid-July, in one year (Van Duzer 1939). Spawning occurred in the daytime, peaking at mid-day and late afternoon at water temperatures of 17-21.5°C. Length of spawning period varied from one to eight days depending on date during the spawning season. Spawning may occur later in Québec. Richardson (1935) indicated that specimens captured in the Eastern Townships in the latter half of August and early September had well-developed ovaries and testes.

In New York and Pennsylvania, females outnumbered males in collections made during July 1979 and in collections made monthly from the winter of 1979/1980 to the winter of 1980/1981 (Pappantoniou *et al.* 1984a, b). The ratio of males to females ranged from 1:1.1 to 1:1.8. The lower number of males in the collections was attributed to higher male mortality caused by nest building and defence activities.

In suitable areas, nests are often built very close to each other. Observations by Van Duzer (1939) indicated that the nest is built by a lone male. After spawning, it may be driven off by a larger male, which may or may not continue nest building prior to spawning. The smaller male may attempt to continue to add stones to the nest or spawn in the absence of the larger male. During spawning from one to 12 females may congregate on one nest, but only one pair spawns at a time.

Successful reproduction of the Cutlip Minnow depends on availability of a specific type of habitat. Spawning habitat in the Susquehanna River system in central New York consisted of a firm rubble bottom overlaid by an abundance of gravel (Van Duzer 1939). Depending on its size, the male selects flat stones with angular margins or thin edges that are 6-24 cm wide. Large flat rocks and submerged logs will offer protection during nest building, spawning, and defence of eggs and fry (Van Duzer 1939). The Cutlip Minnow avoids the stronger current sought by other mound-building cyprinids such as the Creek Chub, *Semotilus atromaculatus*, and the River Chub, *Nocomis micropogon* (Miller 1964). Apparently, current must be sufficiently strong to ensure a constant change of water and prevent excessive siltation, but gentle enough to prevent the removal of stones as small as 6 cm.

Fecundity varied from 345 to 1,177 eggs/female (mean = 792 ± 2 standard deviations of 281.3) in Waccabuc Creek in southeastern New York (Pappantoniou 1983). Fecundity was considerably lower in the Titicus River, New York (mean = 371.9 ± 182.6 eggs/female). Fecundity of the female is apparently not necessarily directly correlated with body size (Pappantoniou 1983).

Physiology and Adaptability

Little is known regarding the physiology of the Cutlip Minnow. Temperature is likely an important limiting factor. It was noted that, in general, Cutlip Minnow in New York State were more long-lived and robust than Pennsylvania counterparts (Pappantoniou *et al.* 1984b). This was attributed to the generally milder climatic conditions in southeastern New York State. Harsher climatic conditions probably adversely affect the life span of Canadian populations. Scott and Crossman (1973) stated that the Cutlip Minnow prefers warm streams. This preference may limit its northward dispersal. The Cutlip Minnow is possibly intolerant of turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973).

Dispersal and Migration

During the spawning season, Cutlip Minnow moves to suitable areas for spawning (Van Duzer 1939). Migration into deeper waters may occur in extremely cold or wet winters (Miller 1964). Haase and Haase (1975) found that the numbers of Cutlip Minnow declined in fall collections. In the Raisin River of Ontario, Cutlip Minnow sites were often separated by large stretches of unsuitable habitat that may inhibit movement; without the opportunity to move between sites, individuals are at risk of site-specific habitat degradation (Jacobs 2011).

Interspecific Interactions

Pappantoniou (1983) suggested that the incidence of eye-picking behaviour in Cutlip Minnow apparently increases with intra-specific density. He suggested that in crowded conditions, such as those that occur in pools in the summer, the Cutlip Minnow may increase access to limited resources by attacking the eyes of other species. Round Goby abundance has increased dramatically in the St. Lawrence River (Farrell *et al.* 2010). Although the impact of Round Goby on Cutlip Minnow has not been studied, Round Goby has had significant impacts on other benthic species (Dubs and Corkum 1996; French and Jude 2001; Balshine *et al.* 2005). The Common Shiner (*Luxilis cornutus*) has been known to breed on the nest of the Cutlip Minnow while the latter attempted to spawn. The presence of the shiners on the nest negatively affected the spawning of the Cutlip Minnow and attempts to drive the shiners off the nest were seldom successful (Van Duzer 1939).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

In Québec, Cutlip Minnow has been collected in 206 waterbodies (Table 1). The species was first recorded in 1935 from the upper section of the Ulverton River (Saint-François river system) and in a few streams of the Nicolet system (Crossman and Holm 1996). At that time, the Cutlip Minnow was considered to be one of the rarest minnows in the Eastern Townships (Richardson 1935). In 1941, the species was also recorded from below the Rapides du Rocher Fendu, lac Saint-Louis, and the Châteauguay, Chaudière, and Saint-Denis river systems (Crossman and Holm 1996). Since then, knowledge of the distribution of the Cutlip Minnow in Québec increased dramatically.

Between 1941 and 1989, it occurred at the greatest number of sites in the rivière Châteauguay system (82 records, 1941-1989) and in the St. Lawrence River below rapides de Lachine in the Montréal region (36 records, 1967-1989) (Crossman and Holm 1996). In the Châteauguay, it was particularly common in the streams of the upper half of the drainage. It ranked 22 out of 53 different species in relative frequency of occurrence in the collections in a 1975-1976 survey of the entire river system (Mongeau *et al.* 1979). It was captured in 1973 at 20 of 108 seining stations in a 25 km stretch of the St. Lawrence River below the Jacques-Cartier Bridge at Montréal. At a few of these sites it was captured in considerable numbers (Massé and Mongeau 1976). Further upstream, immediately below the rapides de Lachine, it was captured in 8 of 114 seining stations in 1977 (Mongeau *et al.* 1980). By 1989, however, it was not considered common in the Montréal region (Dumont and Roy, personal communication, 1989 in Crossman and Holm 1996). It was moderately abundant in the drainage of the Rivière Chaudière (24 records, 1949-1977), Rivière du Chêne (20 records, 1971), and Rivière Nicolet (13 records, 1935-1977). In other river systems, it was not considered common (Crossman and Holm 1996). For example, it was captured at only four of 159 fishing stations in the Rivière Richelieu in 1970 (Mongeau 1979b). It is known from only two sites in the Saint-François river system (Richardson 1935; Mongeau and Legendre 1976) and from only four sites sampled between 1963 and 1975 in a tributary of the Rivière Yamaska (Mongeau 1979a). It was taken in 1980 from below the Rapides du Rocher Fendu, but has not been captured again in Lac Saint-Louis despite attempts in 1965 and 1968 (Mongeau and Massé 1976). Little sampling was carried out between 1977 and 1996 (Dumont and Roy, pers. comm. in Crossman and Holm 1996).

More recently, regional sampling of fish communities has been occurring on a regular basis through Québec's *Réseau de Suivi Ichtyologique* (Fish Monitoring Network); however, summaries of gear, effort, and failed collection attempts are not readily available. Since 2002, the species has been collected in only 79 of 206 waterbodies where it was historically present (Table 1). It is difficult to determine if this is the result of a decline in the species, a lack of sampling in more recent times (not all 206 waterbodies have been sampled since 2002), or a combination thereof. Of note is the recent increase in the number of waterbodies where the species is known to occur in the Laurentian region of southwestern Québec.

In Ontario, the Cutlip Minnow has been collected in seven waterbodies (Table 2). It was first captured in Ontario between 1936 and 1938 at six sites on the Delisle River, Lac Saint-François, the St. Lawrence River, and two small tributaries of the St. Lawrence River, Hosaic Creek and an unnamed tributary. Little sampling within its range occurred between the 1940s and the late 1960s, then relatively intensive sampling using seines and backpack electrofishing was conducted by Ontario Ministry of Natural Resources (OMNR), Royal Ontario Museum (ROM), and Canadian Museum of Nature from the late 1960s to the mid-1980s (Mandrak and Crossman 1992). Targeted sampling for the species has been undertaken in the last decade (e.g. Dextrase and Reid 2004; Mackenzie and Hickey 2008; Hickey 2010; Hogg 2010; Jacobs 2009, 2010, 2011).

The Cutlip Minnow was first captured in Little Rideau Creek, a tributary to the Ottawa River in 1978 and, subsequently, again in 1989, 2004 (Dextrase and Reid 2004), and 2010 (Hogg 2010) (Table 2).

It has been caught at several sites in the St. Lawrence River. In Lac Saint-François, the Cutlip Minnow was caught in 1938, 1994, and 2003 (Table 2). It was caught in the St. Lawrence River at five sites near Cornwall in 2008 and three of the five sites in 2009 (Hickey 2010) and in an adjacent tributary, Rotary Creek, in 2008 and 2009 (Hickey 2010), at Morrisburg in 2009 (Hickey 2010) at Cardinal in 1989 and 2009 (Hickey 2010), and at Ivy Lea in 1936, 1937, and 1994 (Table 2). In 1943, bait dealers considered it to be common in the St. Lawrence River around Ivy Lea (Toner 1943). Attempts to capture the species at Ivy Lea in 1967 (ROM Accession 1276) and 2009 were unsuccessful. Boat electrofishing surveys in August and November 2004 at 10 sites in Lac Saint-François as well as the St. Lawrence River near Cornwall and Maitland did not collect any Cutlip Minnow (Edwards *et al.* 2011). This survey, however, targeted American Eel (*Anguilla rostrata*) and River Redhorse (*Moxostoma carinatum*), and sampling sites likely did not contain habitat for the Cutlip Minnow. Fisheries and Oceans Canada (DFO) did not collect any Cutlip Minnow during extensive boat seining of vegetated habitats at 33 sites sampled in 2005-2011 in the St. Lawrence River around Eastview and Cornwall targeting Pugnose Shiner, *Notropis anogenus* (DFO, unpubl. data). In 2012, two Cutlip Minnow were reported caught near Dewatteville Island (44°33'N, 75°44'W), approximately 5.5 km upstream of Brockville, during young-of-the-year Muskellunge (*Esox masquinongy*) surveys conducted by Muskies Canada in partnership with Parks Canada and the Ontario Ministry of Natural Resources (C. Lake, OMNR, pers. comm. 2012). No voucher specimens, however, were kept for confirmation. If presence of the species is confirmed with a voucher, this location would represent the westernmost collection of the species within its known historical range since 1994.

The Cutlip Minnow has also been caught in the Raisin River in 1973 and 2004, and in the North Raisin River in 1973, 1989, 2004, 2008 and 2009 (Dextrase and Reid 2004; Jacobs 2009, 2010). The species was collected in the Delisle River in 1936, 1938, 1942, 1946, and 1970, but not in 1973 and 1978 (ROM Accessions 2364 and 3765), 2004 (Dextrase and Reid 2004), and 2010 (Jacobs 2011). In 1938, it was collected in Hoasic Creek and an unnamed tributary, but was not collected in more recent sampling (Dextrase and Reid 2004; Jacobs 2010).

Other St. Lawrence tributaries, not historically known to have Cutlip Minnow, were recently unsuccessfully sampled by backpack electrofishing include Finney, Fraser, Gunn, Sutherland, and Wood creeks (Jacobs 2011) and Hughes Creek (Dextrase and Reid 2004).

Abundance

No studies have been conducted specially to determine the abundance or population sizes of Cutlip Minnow in Canada.

Fluctuations and Trends

The lack of ongoing sampling at many locations with historical records makes it difficult to evaluate trends in distribution and abundance. The species does, however, appear to have been lost from two areas in the St. Lawrence River system in Ontario over the last 10 years (Table 2).

Rescue Effect

New York State is the only adjacent jurisdiction with Cutlip Minnow populations connected to Canadian populations. These populations are connected through the St. Lawrence River and some of its tributaries in the western portion of its range. Movement likely occurs across the border in the St. Lawrence River and in tributaries shared by the two countries. As the Cutlip Minnow is considered Secure (S5) in New York, a rescue effect may be possible in the extreme western portion of the range of Cutlip Minnow.

LIMITING FACTORS AND THREATS

Given the geographic distribution of the Cutlip Minnow, low water temperature is likely an important limiting factor. It was noted that, in general, Cutlip Minnow in New York State were more long-lived and robust than Pennsylvania counterparts (Pappantoniou *et al.* 1984b). This was attributed to the generally milder climatic conditions in southeastern New York State. Harsher climatic conditions probably influence the life span of Canadian populations. Scott and Crossman (1973) stated that the Cutlip Minnow prefers warm streams. This preference may limit its northward dispersal.

Interspecific interactions also likely act as natural limiting factors on the Cutlip Minnow. For instance, the breeding of the Common Shiner in the nests of Cutlip Minnow may adversely affect the reproduction of the latter species (Van Duzer 1939). The presence and motion of the shiners on the nest always lessened, and sometimes stopped, the spawning of the Cutlip Minnow. Attempts by the male Cutlip Minnow, occasionally assisted by the female, to drive the shiners off the nest were seldom successful. Miller (1964) noted, however, that the Cutlip Minnow selects quiet channels not usually frequented by breeding shiners and chubs and spawned in late May, whereas, the Common Shiner spawned in the first half of May. Miller also noted, however, that the Common Shiner preferred the nest of the Cutlip Minnow over the nests of chubs and Fallfish (*Semotilus corporalis*).

Specific threats to the Cutlip Minnow are poorly understood. It is probably intolerant of persistent turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973). Urbanization is likely a significant threat to long-term persistence of populations in the Montréal area. Flooding may increase mortality of eggs and fry if they are carried downstream beyond the nest during spawning and early development of the species. Flooding may have caused the reduced 1972 year class of Cutlip Minnow in the Delaware River in eastern Pennsylvania. High water also increases turbidity and scours the benthos, which adversely affects food availability (Haase and Haase 1975). The lack of the Cutlip Minnow along marginal sites on the Raisin and Delisle rivers in Ontario may indicate the sensitivity of this species to habitat degradation such as siltation and loss of aquatic vegetation (Jacobs 2011).

The Cutlip Minnow may be negatively impacted by the invasive Round Goby. Round Goby abundance has increased dramatically in the St. Lawrence River (Farrell *et al.* 2010). Although the impact of Round Goby on Cutlip Minnow has not been studied, Round Goby has had significant impacts on other benthic species (Dubs and Corkum 1996; French and Jude 2001; Balshine *et al.* 2005). A study to determine the effects of the Round Goby on Cutlip Minnow within the St. Lawrence River is now underway (Jacobs 2011). The Tench (*Tinca tinca*), introduced in the late 1990s (Vachon and Dumont 2000), has recently experienced a major range expansion in the Richelieu River and the St. Lawrence River between Montréal and Québec City (Belzile *et al.* 2011, Masson *et al.* in prep.). Tench feed on invertebrates (Michel and Oberdorff 1995) in shallow, vegetated waters and could compete with Cutlip Minnow for food and habitat. The Cutlip Minnow may be caught incidentally by bait fishers; however, based on the Ontario Fishing Regulations, it is illegal in Ontario to use this minnow as bait (Ontario Ministry of Natural Resources 2011) and Drake and Mandrak (2012) rated this potential threat as very low. Considering all threats and their severity, the IUCN Threats Calculator returned an overall threat impact of “Medium - High” (Appendix).

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

The Cutlip Minnow is not listed under the federal *Species at Risk Act* (SARA). Protection is possible through the federal *Fisheries Act* although recent amendments to the Act will only protect habitats of the Cutlip Minnow if they are shared with fishes of commercial, recreational, or Aboriginal fishery significance. It is listed as Threatened by the Ontario *Endangered Species Act*, 2007 (SARO), which prohibits its harvest and protects its habitat.

Non-Legal Status and Ranks

The Cutlip Minnow is listed as secure both globally (G5) and in the United States (N5). In Canada, it is ranked as apparently secure (N4). More specifically, it is considered secure (S5) in Maryland, New York, Pennsylvania and Virginia; apparently secure (S4) in Delaware, New Jersey and West Virginia; vulnerable (S3) in Connecticut and Vermont; and critically imperilled (S1) in North Carolina. In Ontario it is ranked critically imperilled/imperilled (S1S2) and in Québec apparently secure (S4)(NatureServe 2012).

<u>NatureServe status:</u>

Global Heritage Status Rank: G5 (January 2012)
National Heritage Status Rank Canada: N4 (apparently secure)
National Heritage Status Rank United States: N5 (secure)
Provincial Heritage Status Rank Ontario: S1S2 (critically imperiled)
Provincial Heritage Status Rank Québec: S4 (apparently secure)
COSEWIC: Not at Risk (April 1994)
SARO: Threatened

Habitat Protection and Ownership

In Canada, amendments to the federal *Fisheries Act* (in effect as of November 2013) only protect habitats of the Cutlip Minnow if they are shared with fishes of commercial, recreational, or Aboriginal fishery. The revised (2012) *Canadian Environmental Assessment Act* (CEAA) may provide some protection given that species at risk are considered during CEAA reviews and, when projects proceed, measures to avoid or lessen effects and to monitor those effects can be implemented. Not all projects, however, require a CEAA review.

In Québec, habitat is generally protected by "*Loi sur la qualité de l'environnement*" (*Environmental Quality Act*). Fish habitat is also protected by the Wildlife Habitats Chapter IV.I of the "*Loi sur la conservation et la mise en valeur de la faune*" (An Act respecting the conservation and development of wildlife) that, under articles 128.1 to 128.18, controls activities that could modify biological, physical or chemical components peculiar to fish habitat on public lands. All activities that are likely to modify a biological, physical or chemical component of fish habitat are prohibited, aside from the exceptions mentioned in the regulations. Additionally, the "*Loi sur la qualité de l'environnement*" *Environment Quality Act* (EQA) protects fish habitat by prohibiting the release or emission into the environment of any contaminant likely to be prejudicial to wildlife, beyond the quantity or concentration established by the regulations, whether on private or public lands. The EQA also regulates the development and implementation of the "*Politique de protection des rives, du littoral et des plaines inondables"* (Protection policy for lakeshores, riverbanks, littoral zones and floodplains) that aims to protect lakes and streams. This policy establishes minimum standards that must, under the "*Loi sur l'aménagement et l'urbanisme*" (An Act respecting land use planning and development) be adapted in development plans of regional municipalities. Additionally, under the terms of the "Règlement sur les exploitations agricoles" (Agricultural Operations Regulation*)* of the EQA, with the exception of fords, it has been prohibited as of April 1, 2005, to allow livestock free access to waterbodies and shorelines, and land soil fertilization has been regulated.

The Cutlip Minnow receives habitat protection in Ontario under that province's *Endangered Species Act*, *2007*. Other Ontario legislation that may protect habitat of Cutlip Minnow includes the *Environmental Protection Act*, *Ontario Environmental Assessment Act*, *Planning Act*, and *Water Resources Act*. In Ontario, aquatic habitats that fall within regulated lands of a Conservation Authority are protected against wetland infilling, shoreline alterations and work occurring within the floodplain by the *Conservation Authorities Act*.

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The following authorities were contacted and a response received: Canadian Museum of Nature; OMNR Natural Heritage Information Centre; Quinte Conservation Authority; OMNR Glenora; OMNR Kemptville; Raisin Region Conservation Authority; Rideau Valley Conservation Authority; Royal Ontario Museum; Alan Dextrase, OMNR Peterborough.

The following authorities were contacted and a response was not received: Cataraqui Region Conservation Authority; South Nation Conservation.

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Lynn D. Bouvier is a Species at Risk Science Advisor with Fisheries and Oceans Canada in Burlington, Ontario. Lynn has been studying freshwater fish and mussel fauna of the Great Lakes since 2003. Her current interests include biodiversity, fish and mussel species at risk in Canada, and the assessment of the threats negatively affecting these species.

Mary Burridge is an Assistant Curator of Ichthyology in the Department of Natural History, Royal Ontario Museum. With more than 30 years of experience, she has written numerous scientific papers describing new fish species from Southeast Asia and the Indo-Pacific. She has also written popular articles on issues affecting Ontario’s native species, and the ROM’s exhibitions and collections. Mary is a team member of the ROM’s Water Exhibition, the Life in Crisis-Schad Gallery of Biodiversity, and the Patrick and Barbara Keenan Family Gallery of Hands-on Biodiversity. She is also active in outreach programs, visiting schools and youth groups to advocate for Ontario’s native biodiversity.

Erling Holm is Assistant Curator of Ichthyology in the Department of Natural History, Royal Ontario Museum. His interests include the taxonomy and ecology of Canadian freshwater fishes. Since 1986, he has focused on fishes at risk and has co-authored 11 status reports. He manages one of Canada’s largest fish collections, conducts fieldwork in Ontario, and coordinates the ROM’s annual fish identification workshops. He co-authored the ROM Field Guide to Freshwater Fishes of Ontario.

COLLECTIONS EXAMINED

None.

Appendix 1. Threats Assessment Worksheet.

Species or Ecosystem	Cutlip Minnow			
Element ID		**Elcode**		
Date (Ctrl + ";" for today's date):	03/09/2013			
Assessor(s):	Nick Mandrak			
References:				

Overall Threat Impact Calculation Help:

Threat Impact		**Level 1 Threat Impact Counts** high range	low range
A	Very High	0	0
B	High	1	0
C	Medium	1	1
D	Low	1	2
Calculated Overall Threat Impact:		High	Medium

Assigned Overall Threat Impact:	
Impact Adjustment Reasons:	
Overall Threat Comments	Imminent and specific threats are uncertain; few specific studies on potential threat factors (e.g., effects of Round Goby; turbidity), but potential threats are reasonable given general similarities to other fishes where studies have been undertaken

Threat		**Impact (calculated)**	**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development					
1.1	Housing & urban areas					It is probably intolerant of persistent turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973)
1.2	Commercial & industrial areas					
1.3	Tourism & recreation areas					
2	Agriculture & aquaculture					
2.1	Annual & perennial non-timber crops					
2.2	Wood & pulp plantations					
2.3	Livestock farming & ranching					
2.4	Marine & freshwater aquaculture					

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3	Energy production & mining						
3.1	Oil & gas drilling						
3.2	Mining & quarrying						
3.3	Renewable energy						
4	Transportation & service corridors						
4.1	Roads & railroads						
4.2	Utility & service lines						
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	The Cutlip Minnow may be caught incidentally by bait fishers; however, based on the Ontario Fishing Regulations, it is illegal in Ontario to use this minnow as bait (Ontario Ministry of Natural Resources 2011) and Drake and Mandrak (2012) rated this potential threat as very low
6	Human intrusions & disturbance						
6.1	Recreational activities						
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						
7	Natural system modifications						
7.1	Fire & fire suppression						
7.2	Dams & water management/use						
7.3	Other ecosystem modifications						
8	Invasive & other problematic species & genes	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	
8.1	Invasive non-native/alien species	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	Round Goby, Tench; inferred based on studies on other benthic species, but no direct studies available
8.2	Problematic native species		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Common Shiner; although cited in previous report, this threat is considered speculative
8.3	Introduced genetic material						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9	Pollution	BC	High - Medium	Large (31-70%)	Serious - Moderate (11-70%)	Moderate - Low	
9.1	Household sewage & urban waste water	D	Low	Small (1-10%)	Serious (31-70%)	Moderate - Low	It is probably intolerant of persistent turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973)
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents	B	High	Large (31-70%)	Serious (31-70%)	Moderate - Low	It is probably intolerant of persistent turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973)
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	Moderate - Low	
11.1	Habitat shifting & alteration						
11.2	Droughts						
11.3	Temperature extremes						
11.4	Storms & flooding	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	Moderate - Low	Flooding may increase mortality of eggs and fry if they are carried downstream beyond the nest during spawning and early development of the species. Flooding may have caused the reduced 1972 year class of Cutlip Minnow in the Delaware River in eastern Pennsylvania. High water also increases turbidity and scours the benthos, which adversely affects food availability (Haase and Haase 1975).

Classification of Threats adopted from IUCN-CMP, Salafsky *et al.* (2008).